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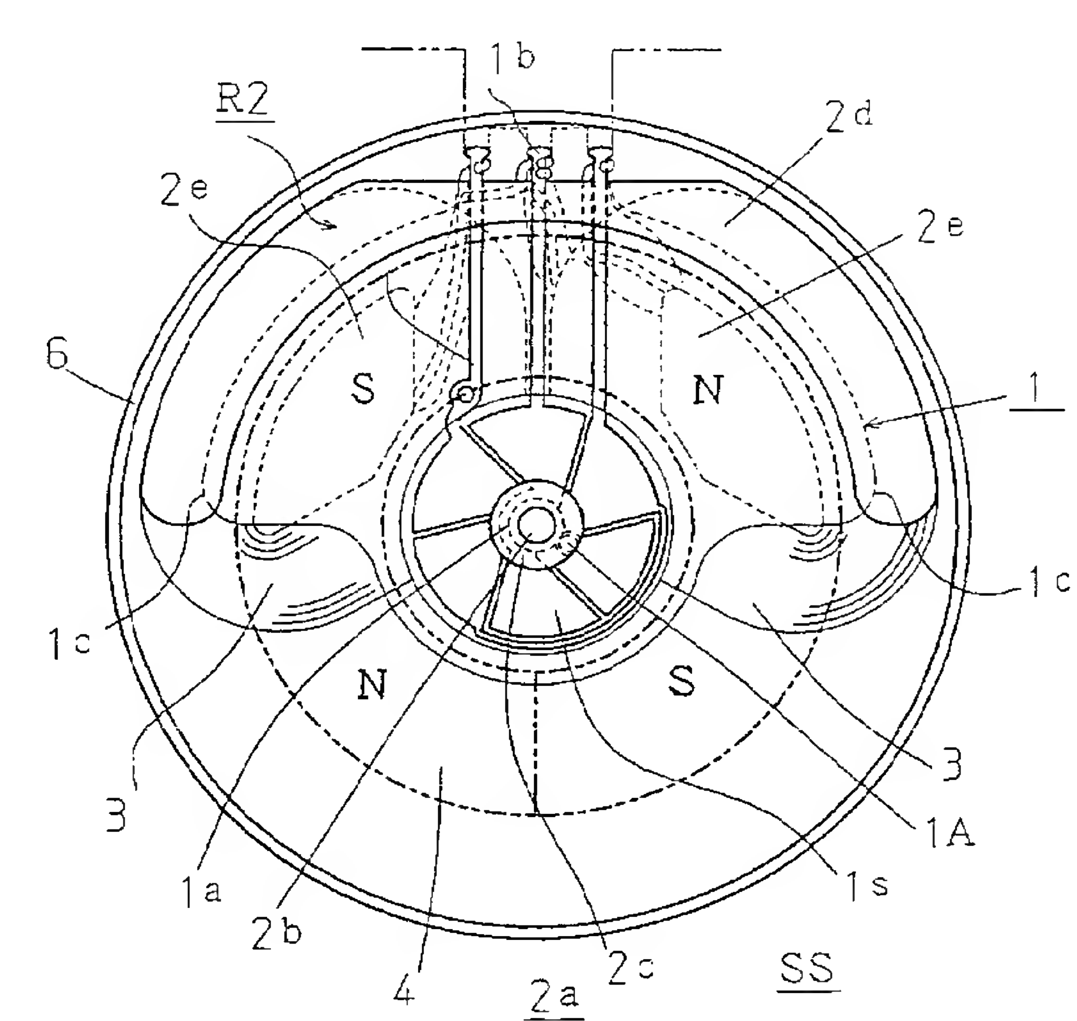
(54) Eccentric rotor

(57) An eccentric rotor is provided in which a bearing is integrally formed with a commutator itself so that the number of parts is reduced, the manufacturing cost is lowered and mass production thereof is possible. The eccentric rotor includes a printed wiring commutator base member (1) where a shaft installation hole (la) is formed at the centre thereof and a plurality of segment patterns (1s) are formed at the periphery of one surface thereof, and formed to be eccentric as an expanded fan viewed from a plane to have an extension portion integrally formed with the segment patterns eccentric, an air-core armature coil (3) integrally formed to be eccentric by an air-core armature coil position determination guide toward the other surface of the printed wiring commutator base member, an end connection portion (1b) of the air-core armature coil arranged at the printed wiring commutator base member within a range of not deviating from the turning circumference during rotation, a bearing portion inserted in the shaft installation hole so that part thereof protrudes toward the segment pattern and simultaneously the other part thereof is extended toward the other surface of the printed wiring commutator base member, and a resin eccentric weight (2f) arranged at the printed wiring commutator base member.

FIG. 1



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Description

[0001] The present invention relates to an eccentric rotor used as a silent call device for a mobile communications apparatus, a compact vibrator motor having the rotor and a method of manufacturing the rotor, and more particularly, to an improvement of assembly and structure of an eccentric rotor which does not require an eccentric weight.

[0002] Referring to FIG. 17, as a silent call device for a pager or a mobile phone, an eccentric weight W made of tungsten alloy is coupled to an output shaft S of a cylindrical DC motor M. When the motor M rotates, vibrations are generated due to the difference in centrifugal force of the eccentric weight W.

[0003] However, in an apparatus such as a pager, as the addition of the eccentric weight W to the output shaft S requires a space in which the eccentric weight W rotates, there is a limit in designing the apparatus. Also, use of the expensive tungsten alloy increases the production costs.

[0004] The present applicant has suggested a cylindrical coreless vibrator motor in Japanese Patent Application No. Hei 2-309070 and the corresponding U.S. Patent No. 5107155, in which a built-in rotor itself is made to be eccentric without using an output shaft. The above motor having no output shaft and no eccentric weight is being favourably noticed by the market as there is no limit in design, use thereof is easy and there is no danger during rotation. However, as the motor requires three cylindrical coreless coils, the number of parts or processing steps increases, thus increasing the production costs.

[0005] In order to make a rotor with a core vibrate instead of the cylindrical coreless coil type rotor, the present applicant has suggested removing one of three salient pole type cores as shown in FIG. 4 of Japanese Patent Publication No. Hei 6-81443. The above two salient pole type cores, where one pole in three phases is missing, are preferable in the case of a motor such as a massager needing a relatively large amount of output. However, for a portable apparatus such as a portable terminal using a low voltage, as the portable apparatus is small, movement of the centre of mass is little (logically nonsense!) and the amount of vibrations is insufficient.

[0006] Also, as disclosed in U.S. Patent No. 5,341,057, the present applicant has suggested a compact vibrator motor having an eccentric armature iron core which is formed by arranging three salient poles made of magnetized material such that they are distributed at one angular side with respect to a rotor to face a field magnet having four alternate north and south pole sections. Also, the same technical concept has been disclosed in Japanese Laid-open Patent Application No. 9-261918. However, as the three armature iron cores made of magnetized material are distributed at one angular side and cogging torque (a force of being absorbed by a field magnet) increases in the case of the motor, a gap needs to be enlarged and the diameter of the motor itself cannot be reduced. Therefore, an improvement of a coreless vibrator motor with no iron core is needed.

[0007] The above motor having a built-in type eccentric rotor becomes a fixed shaft type as it does not need an output shaft. As the size of the above motor is reduced, the distance between armature coils decreases. Thus, connection of the end portion thereof to the commutator without damage to the armature coil is very difficult. Particularly, when a printed circuit board is used as a flat panel commutator as it is, where the end portion of the armature coil is directly welded thereon, welding of the end portion is not easy as the end portion is easily detached from a printed pattern due to elasticity of the end portion.

[0008] According to a first aspect of the present invention, there is provided an eccentric rotor comprising a printed wiring commutator base member where a hole for installing a shaft is formed at the centre thereof, and a plurality of segment patterns are formed at the periphery of one surface thereof to be an eccentric expanded fan shape viewed from a plane to make an extension portion, which is integrally formed with said segment patterns, eccentric, an air-core armature coil integrally formed to be eccentric by an air-core armature coil position determination guide at the other surface of said printed wiring commutator base member, an end connection portion of said air-core armature coil, the end connection portion arranged at said printed wiring commutator base member so that it remains within a range of not deviating from a rotation limit during rotation, a bearing portion inserted in said shaft installation hole so that part of the bearing portion protrudes toward the segment patterns, and simultaneously, the other part of the bearing portion is extended toward the other surface of said printed wiring commutator base member, and a resin eccentric weight arranged at said printed wiring commutator base member.

[0009] Great vibrations can be generated by the rotor itself during rotation by the winding type armature coil and the eccentric weight which are integrally formed to be eccentric. The structure of a built-in type non-mold eccentric rotor according to the present invention provides vibrations with only an eccentric rotor in which the end portion of each armature coil can be easily connected to a commutator.

[0010] The structure allows the armature coil to be easily fixed whilst arranged to be inclined.

[0011] Bearings are incorporated within the commutator itself so that the number of parts are reduced and the manufacturing cost is lowered.

[0012] Sufficient maintenance strength is offered by using a printed wiring commutator base member in arranging a guide for determining the position of an air-core coil and a resin holder having a bearing portion, when a non-molding type flat rotor is configured to solve the problems of the conventional mold type rotor.

[0013] In an eccentric rotor according to the present invention, the nature of sliding and the amount of eccentricity coexist.

[0014] The problems of the conventional mold type rotor are overcome without loss of properties or sacrificing the thickness thereof, by forming a printed wiring coil at the eccentric printed wiring commutator base member constituting a non-mold type flat rotor.

[0015] An eccentric rotor of the present invention can advantageously be used as a low-profile eccentric rotor, that is, a thin vibrator motor.

[0016] The present invention lends itself particularly well to mass production by using the property of a printed wiring type commutator base member.

[0017] A shaft installation hole is formed in the centre of the printed wiring commutator base member for installing the same on a shaft, and a plurality of segment patterns are formed at the periphery of one surface thereof. When the planar surface of the printed wiring commutator base member is viewed from above, it appears to have the shape of an expanded fan, so that the segment patterns thereon are eccentric.

[0018] The air-core armature coil is integrally formed to be eccentric by the air-core armature coil position determination guide toward the other surface of the printed wiring commutator base member. The end connection portion of the air-core armature coil is arranged at the printed wiring commutator base member within a range of not deviating from a rotation limit during rotation.

[0019] The bearing portion is inserted in the shaft installation hole of the printed wiring commutator base member so that part of the bearing portion protrudes toward the segment pattern and the other part of the bearing portion extends toward the other surface of the printed wiring commutator base member. The resin eccentric weight is arranged at the printed wiring commutator base member.

[0020] Preferably, the bearing portion exhibits a feature of sliding of a moving friction coefficient less than or equal to 0.4 (1.5 kg/cm^2) and is installed in a bearing hole located at the centre thereof to be capable of directly rotating to the shaft. As a metal bearing is not needed, production costs can be lowered.

[0021] Preferably, the air-core armature coil position determination guide is formed as a protruding shape, and the air-core armature coil position determination guide and the eccentric weight are connected by a resin passing portion installed at the printed wiring commutator base member for reinforcement. As the printed wiring commutator base member is used as a main frame, the air-core armature coil position determination guide and the resin eccentric weight can be maintained at high strength.

[0022] Preferably, the resin bearing portion, the air-core coil position determination guide and the eccentric weight portion are connected together by the same resin.

[0023] Preferably, in forming a conductive body electrically connecting a predetermined segment pattern of the printed wiring commutator base member at the inner side thereof through a through-hole, the through-hole is used as a resin passing portion when the bearing portion is formed integrally.

[0024] Preferably, the air-core armature position determination guide is a guide insertion hole formed in the printed wiring armature device. The air-core armature coil can be easily installed.

[0025] The bearing portion may be provided with a single sintered oilless bearing. As a feature of sliding needs not be considered, great vibrations can be generated using resin having great density.

[0026] According to another aspect of the present invention, there is provided a compact vibrator motor which includes the described eccentric rotor, a shaft fixed to at least a part of a housing to be described later for supporting the eccentric rotor and allowing the eccentric rotor to rotate, the housing accommodating the eccentric rotor and a magnet for applying a magnetic force to the eccentric rotor through a gap, and a brush arranged at an inner diametric portion of the magnet for supplying electric power to the air-core armature coil through the eccentric rotor segment pattern. A thin axial direction gap type coreless vibrator motor can thus be provided.

[0027] According to another aspect of the present invention, there is provided an eccentric rotor which includes an eccentric printed wiring commutator base member, at least one winding type air-core coil, a bearing portion and a resin eccentric weight.

[0028] The eccentric printed wiring commutator base member may be formed in the shape of an expanded fan viewed from above, in the centre of which a shaft installation hole is formed. A plurality of segment pieces may be exposed toward the periphery of one surface thereof, and at least one armature coil may be formed in a printed wiring manner at at least one surface. The winding type armature coil installation guide may be eccentrically incorporated, and an end connection portion for each coil is arranged in a rotation limit during rotation,

[0029] The winding type air-core coil may be incorporated in the air-core position determination guide and the end portion may be connected to the end connection portion,

[0030] The bearing portion may be inserted in the shaft installation hole so that part thereof protrudes toward the segment pattern and simultaneously the other part thereof is extended toward the other surface of the printed wiring commutator base member.

[0031] The resin eccentric weight may be arranged at a portion where the fan-shaped air-core armature coil of the printed wiring commutator base member is not arranged.

[0032] Due to at least one armature coil formed in print-wiring, an eccentric rotor having a three-phase overlapped armature coil is available without a sacrifice in thickness. As a conductive body contributing to torque

is increased, an effective eccentric rotor is obtained.

[0033] Preferably, the bearing portion is provided with a single sintered oilless bearing.

[0034] Preferably, a printed wiring commutator base member is provided in which an armature coil formed of printed wiring is formed at both surfaces, the device functioning as one coil through a through-hole. As the number of windings of at least one armature coil formed in print-wiring increases, the eccentric rotor becomes more effective.

[0035] Preferably, in forming a conductive body electrically connected to a predetermined segment pattern of the printed wiring commutator base member through the through-hole, the through-hole is used as a resin passing portion when the bearing portion is formed integrally. The intensity of the bearing portion can be sufficiently secured.

[0036] Preferably, the resin holder, air-core coil position determination resin guide and eccentric weight are integrally formed at the printed wiring commutator base member using the same sliding resin exhibiting a density of greater than or equal to 3 and a moving friction coefficient of less than or equal to 0.4 (1.5 kg/cm^2). As the resin molding is performed at one time, productivity is improved.

[0037] According to another aspect of the present invention, there is provided a flat type vibrator motor which comprises an eccentric rotor substantially as described above, a shaft fixed to at least a part of a housing to be described later for supporting the eccentric rotor and allowing the eccentric rotor to rotate, a housing accommodating the eccentric rotor and a magnet for applying a magnetic force to the eccentric rotor, and a brush arranged at an inner diametric portion of the magnet for supplying electric power to the air-core armature coil through the eccentric rotor segment pattern. A flat type vibrator motor is thus provided which can be easily driven and becomes effective.

[0038] According to another aspect of the present invention, there is provided a method of manufacturing an eccentric rotor which is achieved by (a) forming a hold for shaft installation at the centre thereof and at least a plurality of segment patterns at the periphery of one surface thereof, and simultaneously installing an end connection portion on the other side thereof, and also installing a plurality of printed wiring commutator base members where a resin passing portion is formed through a connection portion arranged at the outer circumference thereof, (b) integrally forming a bearing portion with resin exhibiting a sliding property and a moving friction coefficient of equal to or less than 0.4 (1.5 kg/cm^2) by setting the printed wiring commutator base member to an injection mold, (c) integrally installing a winding type armature coil to be eccentric by separating from each connection portion or as it is, in a non-mold manner, and (d) configuring an eccentric rotor by connecting an end portion of the winding type armature coil to the end connection portion.

[0039] Preferably, when the bearing portion is integrally molded in the step (b), the air-core coil position determination guide and the eccentric weight are formed concurrently.

[0040] Preferably, the method further comprises a step of injection-molding at least an eccentric weight portion with resin exhibiting a density of over 3, after the step (b).

[0041] Preferably, as a means for installing a winding type armature coil of the step (c), the air-core armature coil position determination guide is heated and extended.

[0042] In the compact vibrator motor having the above structure according to the present invention for obtaining vibrations with only an eccentric rotor, the connection between the end portions of each air-core armature coil and the commutator is made easy, the armature coil can be easily fixed when installed to be inclined, particularly, mechanical noise can be reduced without using a sintered oil-storing bearing, the number of parts can be reduced by using the commutator as a bearing, and an eccentric rotor having a resin bearing portion which is advantageous in terms of costs can be provided.

[0043] Also, to solve the problems of the conventional mold type rotor, in configuring a non-mold type flat rotor, the resin holder having a bearing portion and the air-core coil position determination guide are arranged using the printed wiring commutator base member so that a sufficient strength is secured and the property of sliding and the amount of eccentricity can be compatibly maintained.

[0044] Further, as the printed wiring coil is formed in the eccentric printed wiring commutator base member forming the non-mold type flat rotor without sacrifice of the thickness, the problems or properties of the conventional mold type rotor can be solved. Thus, a low profile eccentric rotor, that is, a thin type vibrator motor can be provided. Also, using the advantages of the printed wiring commutator base member, a method of manufacturing a non-mold type flat rotor capable of mass production can be provided.

[0045] Examples of the present invention will now be described in detail with reference to the accompanying drawings in which:

FIG. 1 is a plan view showing major portions of a flat type coreless vibrator motor having an eccentric rotor according to the first preferred embodiment of the present invention;

FIG. 2 is a plan view showing major portions of a vibrator motor using an eccentric rotor according to a modified example of FIG. 1 (the second preferred embodiment) of the present invention;

FIG. 3 is vertical sectional view taken along line α-β of FIG. 2;

FIGS. 4A and 4B show a modified example of the vibrator motor according to the third preferred embodiment of the present invention, in which FIG. 4A

is a plan view of a rotor portion viewed from one side of a segment and FIG. 4B is a bottom view thereof viewed from the segment's other side;

FIG. 5 is a vertical sectional view taken along line γ-δ of FIG. 4;

FIG. 6 is a vertical sectional view of a modified example of the vibrator motor of FIG. 4;

FIGS. 7, 8 and 10 are bottom views for explaining a method of manufacturing major members of the eccentric rotor according to the present invention;

FIG. 9 is a plan view of the eccentric rotor according to the present invention;

FIG. 11 is a bottom view showing major portions of the eccentric rotor used for the fourth preferred embodiment of the present invention (viewed the other side of the segment);

FIG. 12 is a plan view of the eccentric rotor, viewed from one side of the segment;

FIG. 13 is a bottom view showing the eccentric rotor integrated with a resin holder, viewed from the segment's side;

FIG. 14 is a plan view of the eccentric rotor integrated with a resin holder and formed into a non-mold type flat rotor, viewed from the opposite side of the segment;

FIG. 15 is a vertical sectional view of an axial direction gap type coreless vibrator motor using major members of the eccentric rotor shown in FIG. 9, taken along line ε-η of FIG. 9;

FIG. 16 is a view for explaining the operation of the axial direction gap type coreless vibrator motor using the above rotor; and,

FIG. 17 is a perspective view showing a conventional compact vibrator motor.

[0046] FIG. 1 shows major portions of a flat type coreless vibrator motor having an eccentric rotor according to the first preferred embodiment of the present invention. Reference numeral 1 denotes an eccentric commutator base member made of a printed wiring circuit board which is shaped as an expanded fan when the planar surface thereof is viewed from above and has a shaft installation hole 1a formed at the centre thereof. To encompass the eccentric commutator base member 1, highly slippery resin 2 exhibiting high density and a specific gravity of 6 is integrally and thinly formed on the entire surface of the fan-shaped eccentric commutator base member 1, so as to form an eccentric commutator SS. Six printed wiring segment patterns 1s having slits which are inclined form the radial direction for preventing sparking, are arranged at the eccentric commutator base member 1. An armature coil end connection terminal 1b (to be described later) protrudes from the semicircular arc shaped bottom portion of three segment patterns at the movement of the centre of mass. The eccentric commutator base member 1 is installed, by being extended with a reinforced portion 1c, to the inside of both ends 2a of a half-circle of which both ends are formed of high density highly slippery resin 2. Each of the segment patterns 1s are electrically connected to the segment patten on the opposite side of the shaft by a pattern on the surface and a through-hole 1a. A resin bearing holder 2a ascends from the high density highly slippery resin 2 toward the opposite segment pattern in the shaft installation hole la at the centre of the eccentric commutator base member 1. A bearing hole 2b is formed at the centre of the eccentric commutator base member 1 and is maintained at the eccentric commutator base member 1 by a dam portion 2c protruding toward the segment pattern from the high density, highly slippery resin 2.

[0047] In the eccentric commutator base member 1 having the above structure, an arc shaped portion 2d which becomes a portion of an eccentric weight for the movement of the centre of mass is installed at the semicircular outer circumferential portion. Air-core armature coil position determination fixing guides 2e, described later, are integrally formed with the high density, highly slippery resin 2, as indicated by a dotted line, at the inside surface of each of the six segment patterns 1s at an arranged open angle of 120°. The air-core armature coils 3 made of a winding around a self-fusing line are inserted in the air-core armature coil position determination fixing guides 2e and the beginning and termination end portions of the winding are wound around the armature coil end connection terminal 1b, and dip-soldered thereto, through a predetermined groove so as to not protrude above the thickness of the rotor, thus forming an eccentric rotor R2. A flat, circular magnet 4 for driving the rotor has north (N) and south (S) poles which are alternately positioned in four quadrants.

[0048] Also, the principle of operation in which one phase is open in the above three phase armature coil will be omitted as it is a well-known technology.

[0049] FIG. 2 shows a cross sectional view of the vibrator motor of FIG. 1 in which a modified eccentric rotor is used; and FIG. 3 shows a vertical sectional view of the vibrator motor shown in FIG. 2. The eccentric commutator base member 11 is formed to be a sector slightly greater than a semicircle and the armature coil end connection terminals 1f is installed opposite to the eccentric commutator base members 11 with respect to the centre of mass, unlike the above embodiment.

[0050] A notch f for hooking is formed at each of the armature coil end connection terminals 1f. The armature coil end connection terminal 1f is disposed so as not to overlap the air-core armature coils 3, when the planar surface thereof is viewed from above so that the connection to the end portion is made easy.

[0051] In the shaft installation hole 1a at the centre of the eccentric commutator base member 11, a resin bearing holder 2a lifted from the semicircular high density, highly slippery resin 2 is installed by being extended toward the opposite position of the segment pattern, and a bearing hole 2b is formed at the centre thereof. A dam portion 2c formed of the high density, highly slippery res-

in 2 protrudes toward the segment pattern. The second dam portion 2cc for reinforcement is installed further toward the segment pattern at the part of the resin bearing holder 2a via the through-hole 1A. Each of the dam portions 2c and 2cc is molded to prevent the resin from flowing the slits between each segment 1s.

[0052] The air-core armature coils 3 made of a winding around a self-fusing line are inserted in the air-core armature coil position determination fixing guides 2e and the beginning and termination end portions of the winding are soldered to the armature coil end connection terminal 1f, so as not to protrude above the thickness of the rotor, thus forming an eccentric rotor R3. Preferably, the air-core armature coil position determination fixing guides 2e, which fix the air-core armature coils 3 in place, are deformed by heating and fused, or are fixed by a reflow of powder or solid epoxy.

[0053] The motor including the eccentric rotor R3 is an axial direction gap type motor and is driven by the flat, circular magnet 4. Reference numeral 5 of FIG. 3 denotes a bracket made of a tin-plated steel plate for maintaining the magnet 4 and concurrently providing a magnetic path. The bracket 5 forms a housing with a case 6. A shaft J is rotatably installed through the bearing hole 2b of the resin bearing holder 2a. A pair of brushes 7 disposed at the bracket 5 sliding-contact the segment pattern at an open angle of 90° so that power is supplied to the armature coils 3 from the outside via a flexible substrate 8.

[0054] FIGS. 4A and 4B show a modified shape of the second preferred embodiment shown in FIG. 2, in which FIG. 4A is a cross sectional view of one side of the commutator and FIG. 4B is a cross sectional view of the other side of the commutator. That is, reference numeral 111 denotes a fan-shaped printed wiring commutator device and six segments 1s, surfaces of which are plated with a noble metal and having inclined slits, are arranged on one side thereof for spark prevention. A conductive body for electrically connecting the segments opposite to each other among the above segments is formed at an inner surface via a through-hole 1A. Reference numerals 1h, 1i, 1j and 1k denote resin passing portion which are one of the features of the present invention. The resin passing portion are reinforced when a resin holder, an air-core coil position determination guide, an eccentric weight which will be described later are integrally formed with the printed wiring commutator base member 11. The resin passing portions 1h and 1i are installed at the air-core coil position determination guide, the resin passing portions 1j and 1k formed by notching a part of the outer circumference are installed at the eccentric weight, and the through-hole 1B is installed at the resin bearing holder 2a.

[0055] A sliding portion 2h, where the bearing hole 2b and an oil storing groove rotatably installed at a shaft (which will be described later) are coaxially installed, is arranged at the resin bearing holder 2a, and passes through the through-hole 1A by leg portions which are arranged to be well balanced. The second dam portion 2cc at the surface and the first dam portion 2c at the central portion are reinforced by being coated with resin.

[0056] Part 2f of the eccentric weight lifts the arc-shaped portion 2d of the eccentric weight toward the segment through the resin passing portion 1j. Both ends of the arc-shaped portion 2d of the eccentric weight are tapered to prevent loss of wind during rotation.

[0057] Next, FIG. 5 shows a flat coreless vibrator motor using the eccentric rotor R3. As the bearing hole 2b has a recess c of a few microns formed inside, loss of bearing is reduced. In a means for forming the recess c, the middle portion of the resin holder 2a is thicker than other portions as shown in the drawing so that a recess can be easily formed using the difference in percentage of contraction of resin. Also, the few-micron recess can be fabricated by excessive drawing with a mold pin.

[0058] The air-core coil position determination guide, the air-core armature coil 3 and the eccentric weight can be formed together with the single resin injection molding according to the above method. Thus, the structure is simplified and the cost is lowered. Also, as the air-core coils 3 can be directly installed at the printed wiring commutator base member 11, a gap can be made small and efficiency is increased.

[0059] Also, as shown in FIG. 6, it is possible that the resin bearing holder 22a is formed of low density sliding resin and then the air-core coil position determination guides 2e and the eccentric weight portion is molded with a high density resin. In this case, a sintered oilless bearing can be used instead of the resin bearing holder 22a.

[0060] FIGS. 7, 8, 9 and 10 show a basic method of manufacturing an eccentric rotor having the above eccentric printed wiring commutator base member. FIGS. 7, 8 and 10 are bottom views and FIG. 9 is a plan view. That is, eccentric printed wiring commutator base members 1, 11 and 111 are integrally connected by the connection portions 1g at the same pitch for mass production and are manufactured using press.

[0061] The printed wiring commutator base member 11 manufactured in the above method, as shown in FIGS. 8, 9 and 10, is set to an injection mold installed by being connected plurally at the same pitch. By outsert molding using resin having a specific gravity of, for example, 4-5, and a friction coefficient of 0.3 (15 kg/cm^2), the resin holder 2a, the two air-core coil position determination guides 2e, and the part 2f of the eccentric weight connected to the resin bearing holder 2a are installed at the opposite side of the segment.

[0062] The bearing hole 2b in which the shaft J is rotatably installed, at which will be described later, and the sliding portion 2h where the oil storing groove is coaxially installed are arranged at the resin holder 2a. The leg portions which are arranged to be well balanced, penetrate the through-holes 1A and the second dam portion 2cc at the surface, and the first dam portion 2c at the central portion are coated with resin for reinforce-

ment.

[0063] The part 2f of the eccentric weight lifts the arc-shaped portion 2d of the eccentric weight toward the segment through the resin passing portion 1j. Both ends of the other part 2d of the eccentric weight are tapered like the above leg shape to prevent loss of wind during rotation.

[0064] The air-core armature coils 3 are inserted in the air-core armature coil position determination guides 2e and the ends of a winding are hooked and soldered on notches f of the three air-core coil end connection terminals 1f, thus forming the eccentric rotor. In the drawing, r denotes a printed resistor for preventing spark.

[0065] Also, as a fixing method of the air-core armature coil 3, preferably, a head portion 2ee of the air-core armature coil position determination guide 2e is pressed and heated by a wedge-shaped jig, or powdered epoxy is heated and cured or fixed in a reflow manner using an ultraviolet curing type adhesive. Also, although one phase is open in the three-phase armature coil, a description thereof will be omitted as the principle of operation is a well-know technology.

[0066] FIGS. 11 and 12 show an eccentric rotor according to the fourth preferred embodiment of the present invention. Here, reference numeral 12 denotes an eccentric printed wiring commutator base member formed to be an expanded fan shape when the planar surface thereof viewed from above, in which a shaft installation hole 1a is formed at the centre thereof at the same time as the six segments 1s of which surfaces are plated with the noble metal and having inclined slits installed at one side thereof for spark prevention. Part C3 of the armature coil is print-wired above the segments 1s, part C4 of the armature coil is print-wired on the other side of the eccentric printed wiring commutator 12, and the parts C3 and C4 are connected in series through the through-hole 1A to form a single armature coil. The resin passing portions 1h, 1k and 1n, which are characteristic features of the present invention, are reinforced when the resin bearing holder, the air-core coil position determination resin guide, and the resin eccentric weight are integrally formed with the printed wiring commutator base member 11 as described above. The resin passing portion 1h is hooked by the air-core coil position determination resin guide and the resin eccentric weight, the slit 1n and the resin passing portion 1k formed by notching part of the outer circumference are hooked by the resin eccentric weight, and the through-hole 1A is hooked by the resin bearing holder. In the drawing, reference numeral 2ef denotes a space for drawing the end portion of the air-core armature coils 3.

[0067] A plurality of printed wiring commutator base members 12, which have the above structure and are connected with the same pitch, are set to an injection mold, as shown in FIG. 10. As shown in FIG. 14, by outset molding using resin of about specific gravity 4-5 and moving friction coefficient of 0.3 (15 kg/cm^2), the resin holder 2a, the two air-core coil position determination guides 2e, and the part 2f of the eccentric weight connected to the resin bearing holder 2a are installed at the opposite side of the segment.

[0068] The axial direction gap type coreless vibrator motor using the above eccentric rotor R5 is assembled as shown in FIG. 15. Here, it is characteristic that an insulated copper wire 9 is embedded in the eccentric weight. In this case, the insulated copper wire 9 is coated with polyurethane except for cut-away portions of both ends thereof and formed to be arc-shaped so as not to be shorted by the printed wiring armature coil located inside. As a result, the position of the centre of mass can be moved much further so that vibrations become greater.

[0069] In the principle of operation of the axial direction gap type coreless vibrator motor using the eccentric rotor R5, referring to FIG. 16, when a DC voltage from a power source (not shown) is applied to a main and sub brush pair 7, at the position of 0 degrees, current flows in a direction indicated by arrows in the left and right winding type armature coils 33 and 34 via the printed wiring commutator, and rotational torque in a direction indicated by arrow A is generated according to Fleming's left-hand rule. When the rotation proceeds to a degree of 60°, rotational torque in the direction of arrow A is generated by the printed wiring armature coil D1 and the winding type air-core armature coil 34. Anti-torque preventing rotation is not generated at other positions. Thus, as long as the power is supplied, the rotation continues cyclically. As two armatures are always electrically connected in three three-phase armatures, torque is improved compared to two three-phase armatures where one armature is open.

[0070] Also, it is preferable that, in integrally forming the resin holder 2a in the printed wiring commutator base member, part of a copper pattern portion which is a boundary with the resin portion is made wider by molding so as not to be shorted.

Claims

1. An eccentric rotor comprising:

   a printed wiring commutator base member (1, 11, 111) where a hole (1a) for installing a shaft is formed at the centre thereof, and a plurality of segment patterns (1s) are formed at the periphery of one surface thereof to be an eccentric expanded fan shape viewed from a plane to make an extension portion, which is integrally formed with said segment patterns, eccentric;
   an air-core armature coil (3) integrally formed to be eccentric by an air-core armature coil position determination guide at the other surface of said printed wiring commutator base member;

an end connection portion of said air-core armature coil, the end connection portion arranged at said printed wiring commutator base member so that it remains within a range of not deviating from a rotation limit during rotation;
a bearing portion inserted in said shaft installation hole so that part of the bearing portion protrudes toward the segment patterns, and simultaneously, the other part of the bearing portion is extended toward the other surface of said printed wiring commutator base member; and
a resin eccentric weight arranged at said printed wiring commutator base member.

2. An eccentric rotor according to claim 1, in which said bearing portion exhibits a feature of sliding of a moving friction coefficient equal to or less than 0.4 (1.5 kg/cm^2) and is installed in a bearing hole (2b) located at the centre to be capable of directly rotating with respect to the shaft.

3. An eccentric rotor according to claim 1 or 2, in which said air-core armature coil (3) is formed to protrude, and said air-core armature coil position determination guide and said eccentric weight are connected by a resin passing portion (1h-1k) installed at said printed wiring commutator base member for reinforcement.

4. An eccentric rotor according to any of claims 1 to 3, in which said resin bearing portion, said air-core armature coil position determination guide and said eccentric weight portion are connected together by the same body of resin.

5. An eccentric rotor according to any of the preceding claims, in which, in forming a conductive body for electrically connecting a predetermined segment pattern of said printed wiring commutator base member (1, 11, 111) at the inner side thereof through a through-hole (1a), the through-hole is used as a resin passing portion (1h-1k) when said bearing portion is formed integrally.

6. An eccentric rotor according to any of the preceding claims, in which said air-core armature position determination guide is a guide insertion hole formed in said printed wiring commutator base member (1, 11, 111).

7. An eccentric rotor according to any of the preceding claims, in which said bearing portion is provided with a single sintered oilless bearing.

8. A compact vibrator motor comprising:

an eccentric rotor according to any one of claims 1 to 7;
a shaft fixed (J) to at least a part of a housing for supporting said eccentric rotor and allowing said eccentric rotor to rotate;
said housing accommodating said eccentric rotor and a magnet (4) for applying a magnetic force to said eccentric rotor, wherein a gap exists between said eccentric rotor and said magnet; and
a brush (7) arranged at an inner diametric portion of said magnet for supplying electric power to said air-core armature coil (3) through said eccentric rotor segment pattern (1s).

9. An eccentric rotor comprising:

an eccentric printed wiring commutator base member (1, 11, 111) formed to be an expanded fan shape viewed from a plane, in which a shaft installation hole (1a) is formed at the centre thereof, a plurality of segment pieces (1s) are exposed toward the periphery of one surface thereof, at least one armature coil is formed in a printed wiring manner at at least one surface, a winding type armature coil installation guide is eccentrically incorporated, and an end connection portion (1b) for each coil is arranged in a rotation limit during rotation;
at least one winding type air-core coil (3) incorporated in said armature coil installation guide and the end portion is connected to said end connection portion;
a bearing portion inserted in said shaft installation hole so that part of the bearing portion protrudes toward the segment pattern and simultaneously the other part of the bearing portion is extended toward the other surface of said printed wiring commutator base member; and
a resin eccentric weight (2f) arranged at a portion where said fan-shaped air-core armature coil of said printed wiring commutator base member is not arranged.

10. An eccentric rotor according to claim 9, in which a printed wiring commutator base member (1, 11, 111) is provided in which an armature coil (3) formed by the printed wiring is formed at both surfaces, said device functioning as one coil through a through-hole (1a).

11. An eccentric rotor according to claim 9 or 10, in which, in forming a conductive body for electrically connecting a predetermined segment pattern of said printed wiring commutator base member (1, 11, 111) through the through-hole (1a), the through-hole is used as a resin passing portion (1h-1k) when said bearing portion is formed integrally.

12. An eccentric rotor according to claim 9, 10 or 11, in

which a resin holder (2a) and the air-core coil position determination resin guide and eccentric weight (2f), are integrally formed at said printed wiring commutator base member (1, 11, 111) using the same sliding resin exhibiting the density of equal to or less than 3 and a moving friction coefficient of less than or equal to 0.4 (1.5 kg/cm^2).

13. A flat type vibrator motor comprising:

an eccentric rotor according to any of claims 9 to 12;
a shaft (J) fixed to at least a part of a housing for supporting said eccentric rotor and allowing the eccentric rotor to rotate;
a housing accommodating said eccentric rotor and a magnet (4) for applying a magnetic force to said eccentric rotor; and
a brush (7) arranged at an inner diametric portion of said magnet for supplying electric power to said air-core armature coil (3) through said eccentric rotor segment pattern.

14. A method of manufacturing an eccentric rotor comprising the steps of:

(a) forming a shaft installation hole at the centre of an eccentric rotor and at least a plurality of segment patterns at the periphery of one surface thereof, and simultaneously installing an end connection portion on the other side thereof, and also installing a plurality of printed wiring commutator base members where a resin passing portion is formed through a connection portion arranged at the outer circumference thereof;
(b) integrally forming a bearing portion with resin exhibiting a slipping property and a moving friction coefficient of equal to or less than 0.4 (1.5 kg/cm^2), by setting said printed wiring commutator base member to an injection mold;
(c) integrally installing a winding type armature coil by separating said printed wiring commutator base members from each connection portion or making itself eccentric, in a non-mold manner; and
(d) configuring the eccentric rotor by connecting an end portion of said winding type armature coil to said end connection portion.

15. A method according to claim 14, in which, when said bearing portion is integrally molded in said step (b), said air-core coil position determination guide and said eccentric weight are formed concurrently.

16. A method according to claim 14 or 15, further comprising a step of injection-molding at least an eccentric weight portion with resin exhibiting density over 3, after said step (b).

17. A method according to any of claims 14 to 16, in which, as a means for installing a winding type armature coil of said step (c), said air-core armature coil determination guide is heated and extended.

FIG. 1

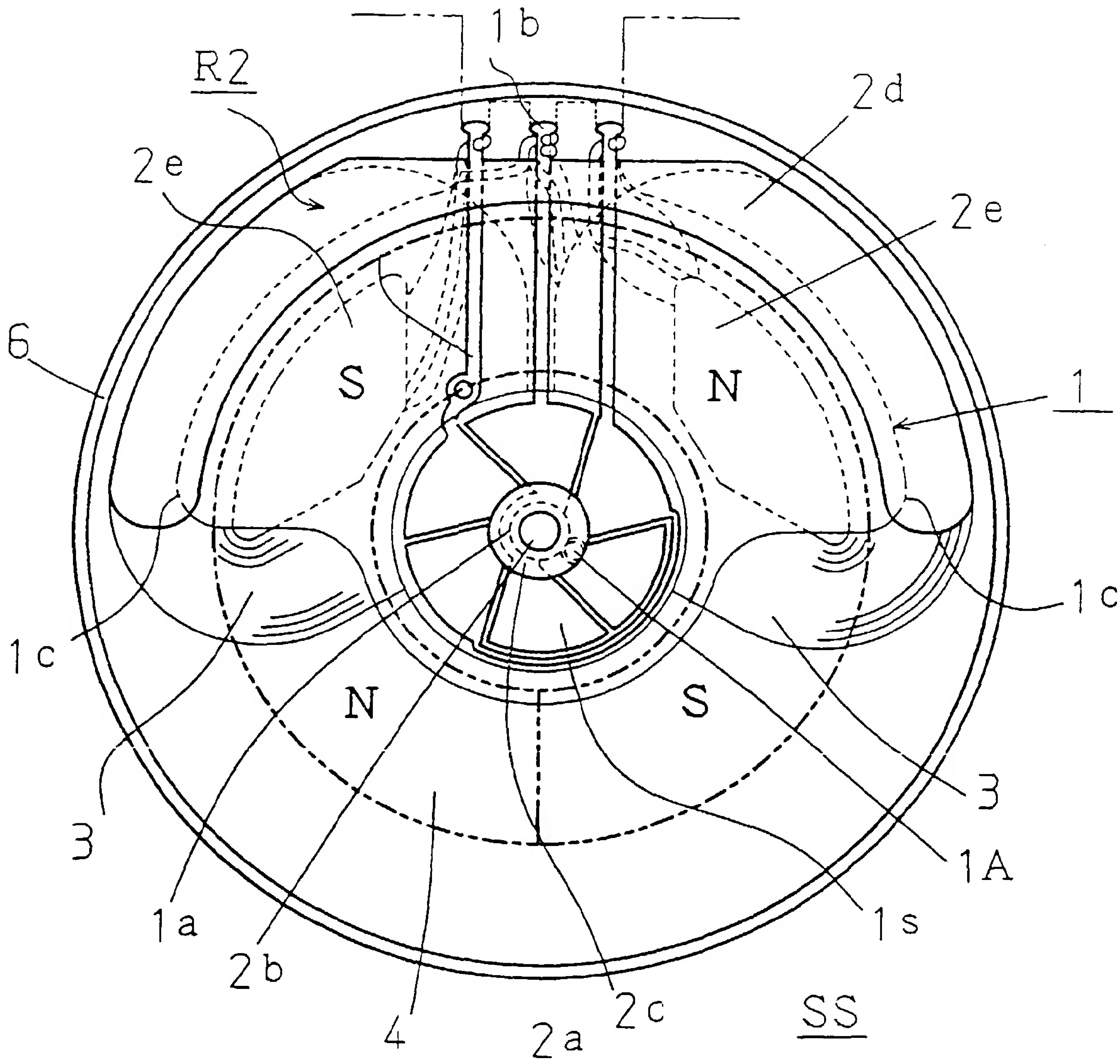


FIG. 2

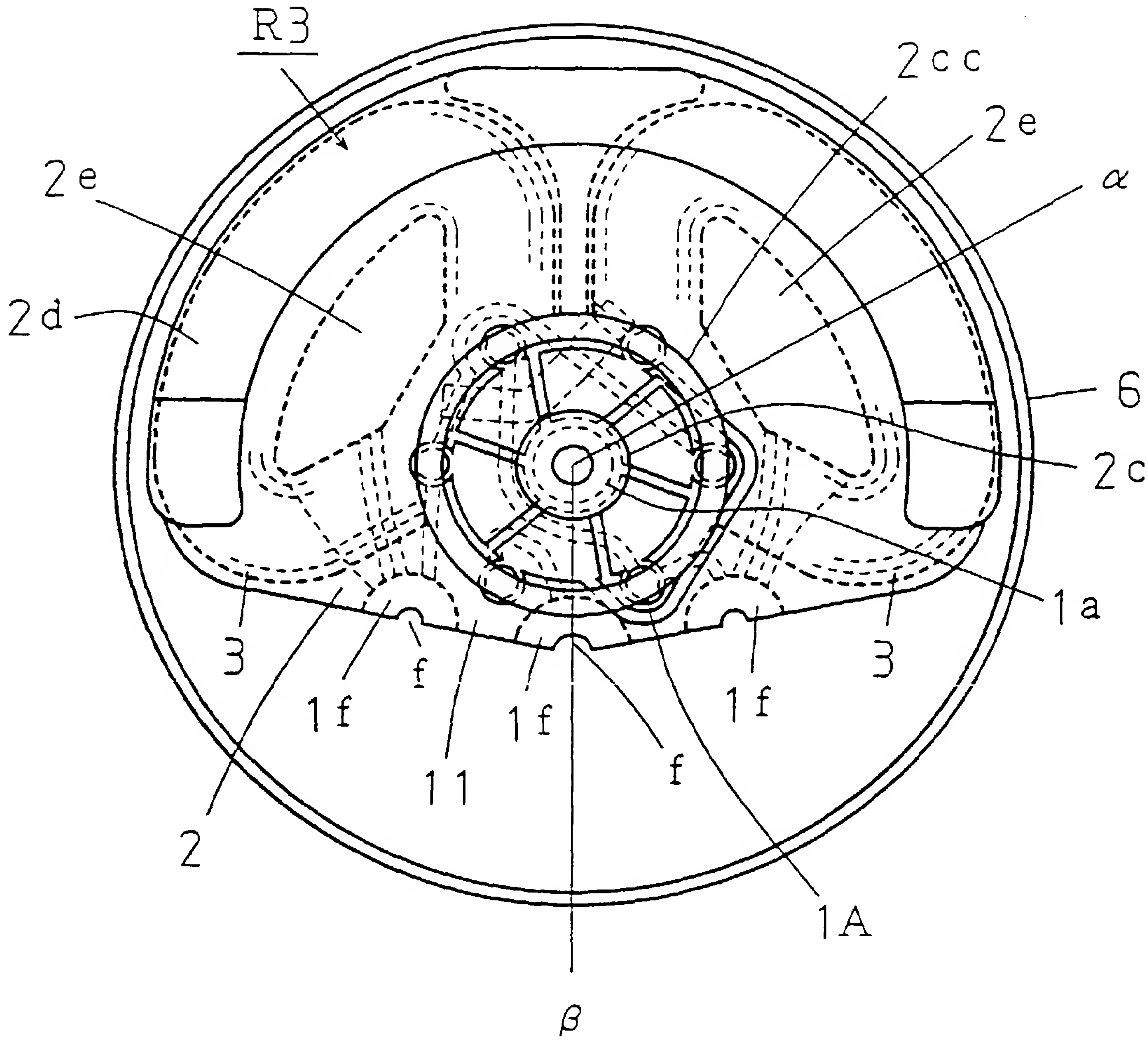


FIG. 3

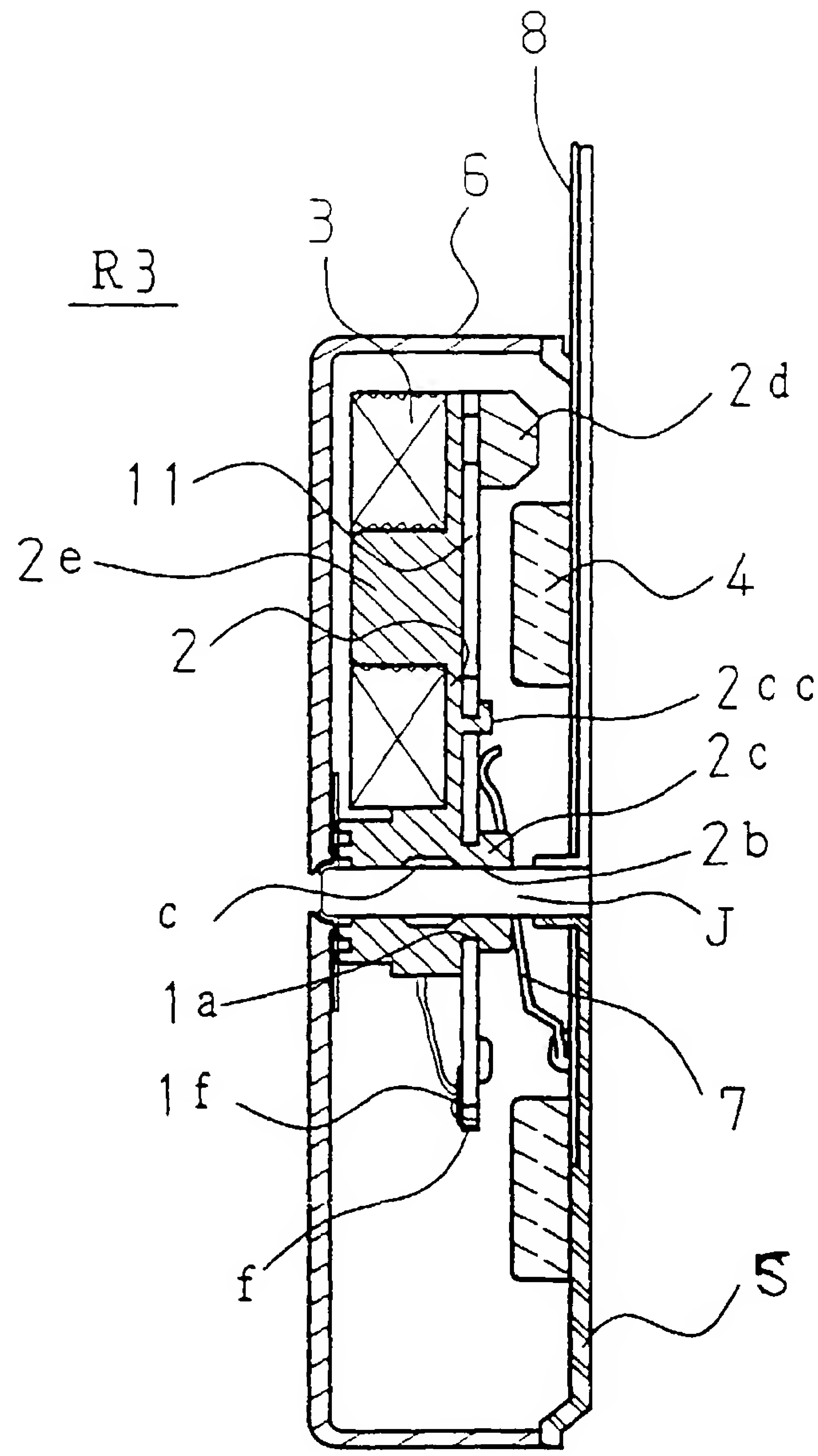


FIG. 4A

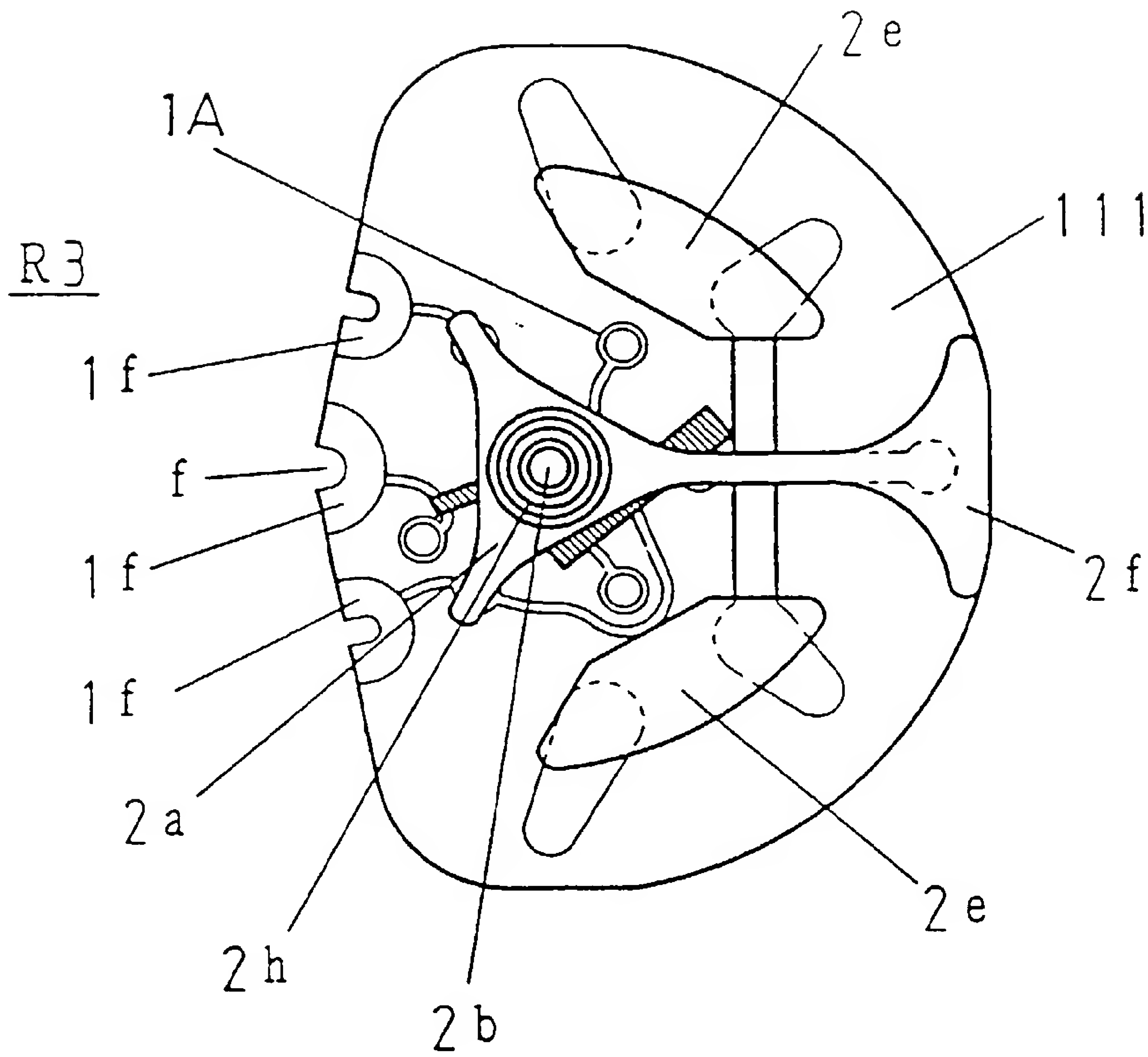


FIG. 4B

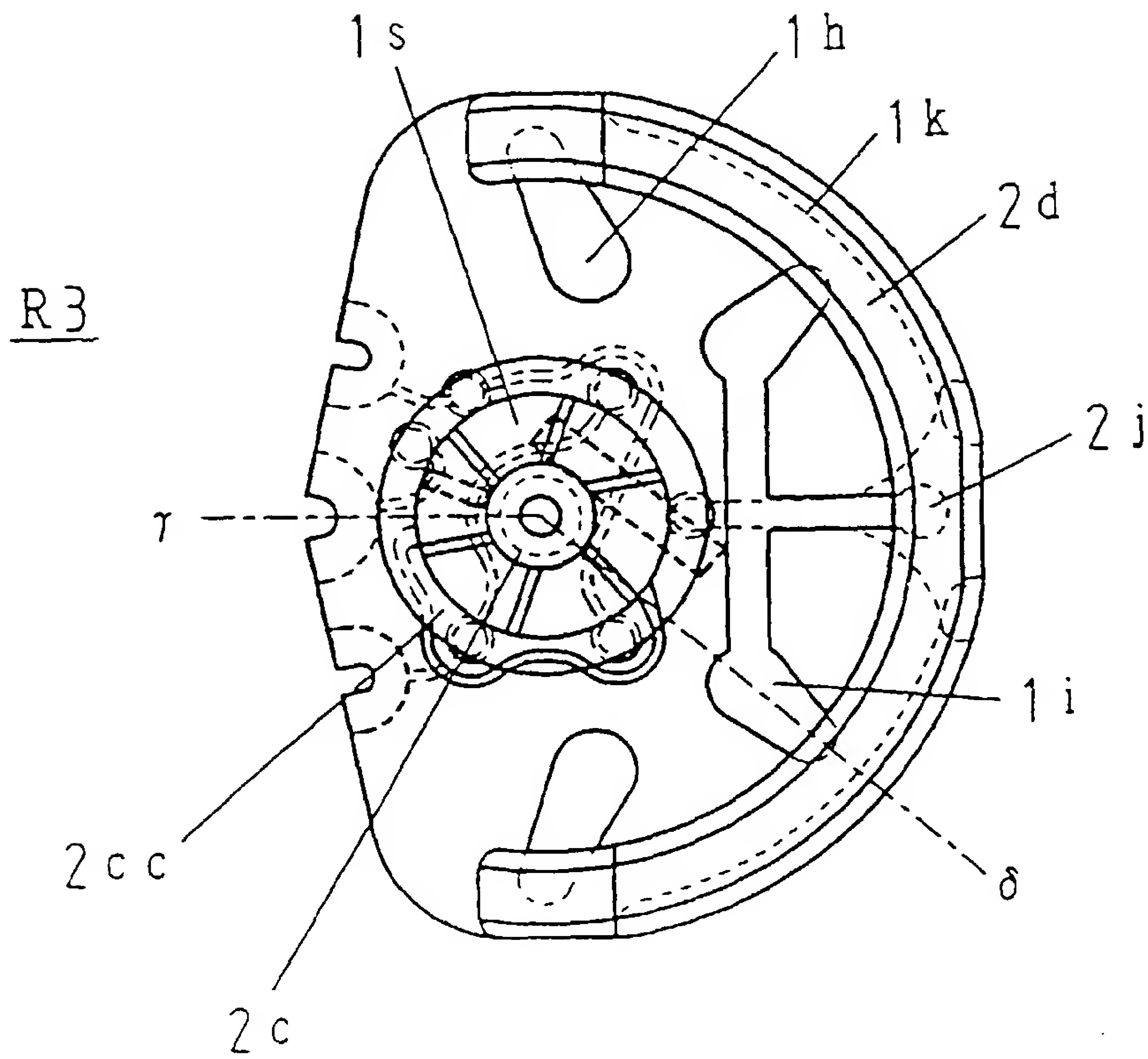


FIG. 5

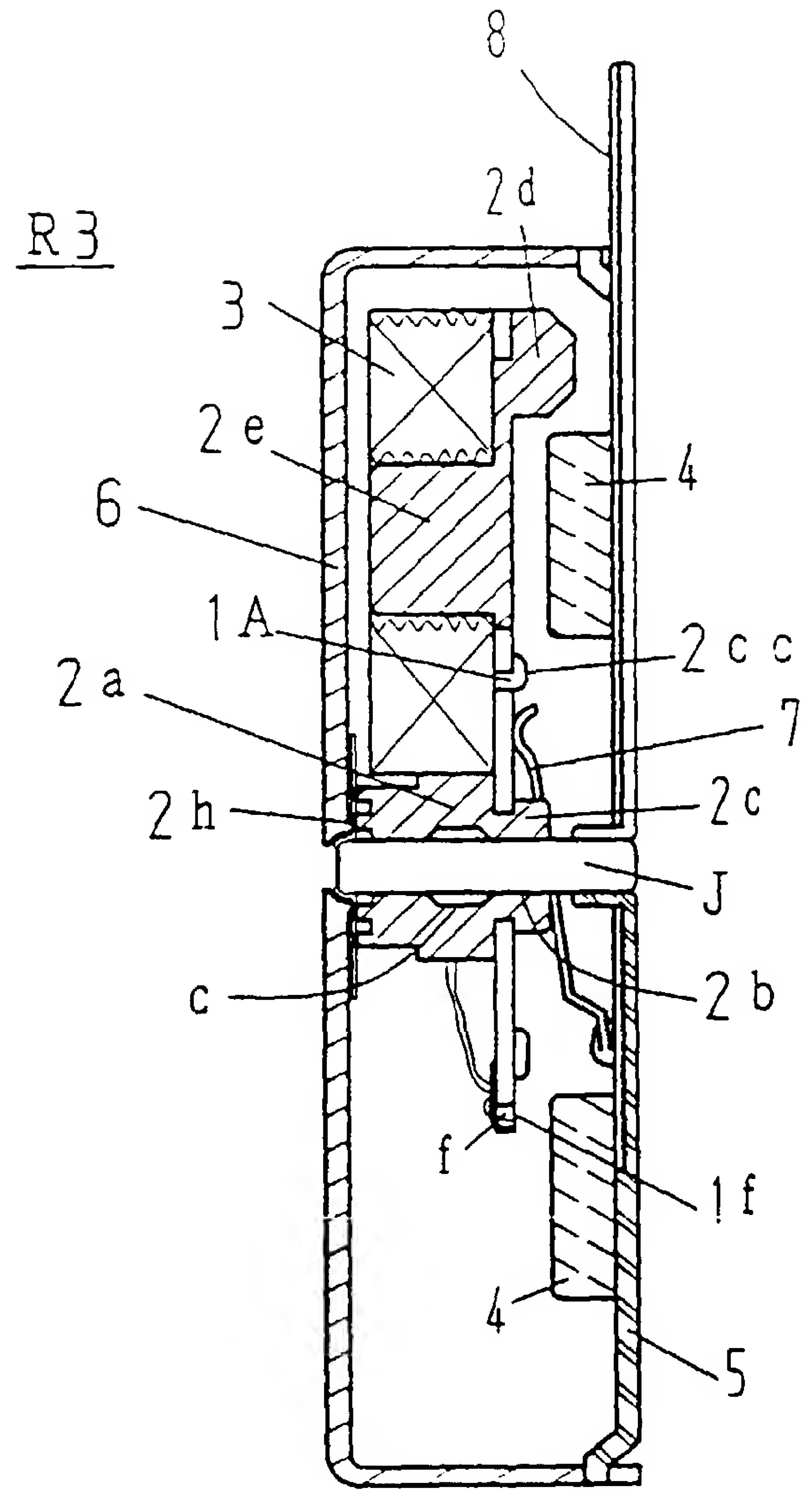


FIG. 6

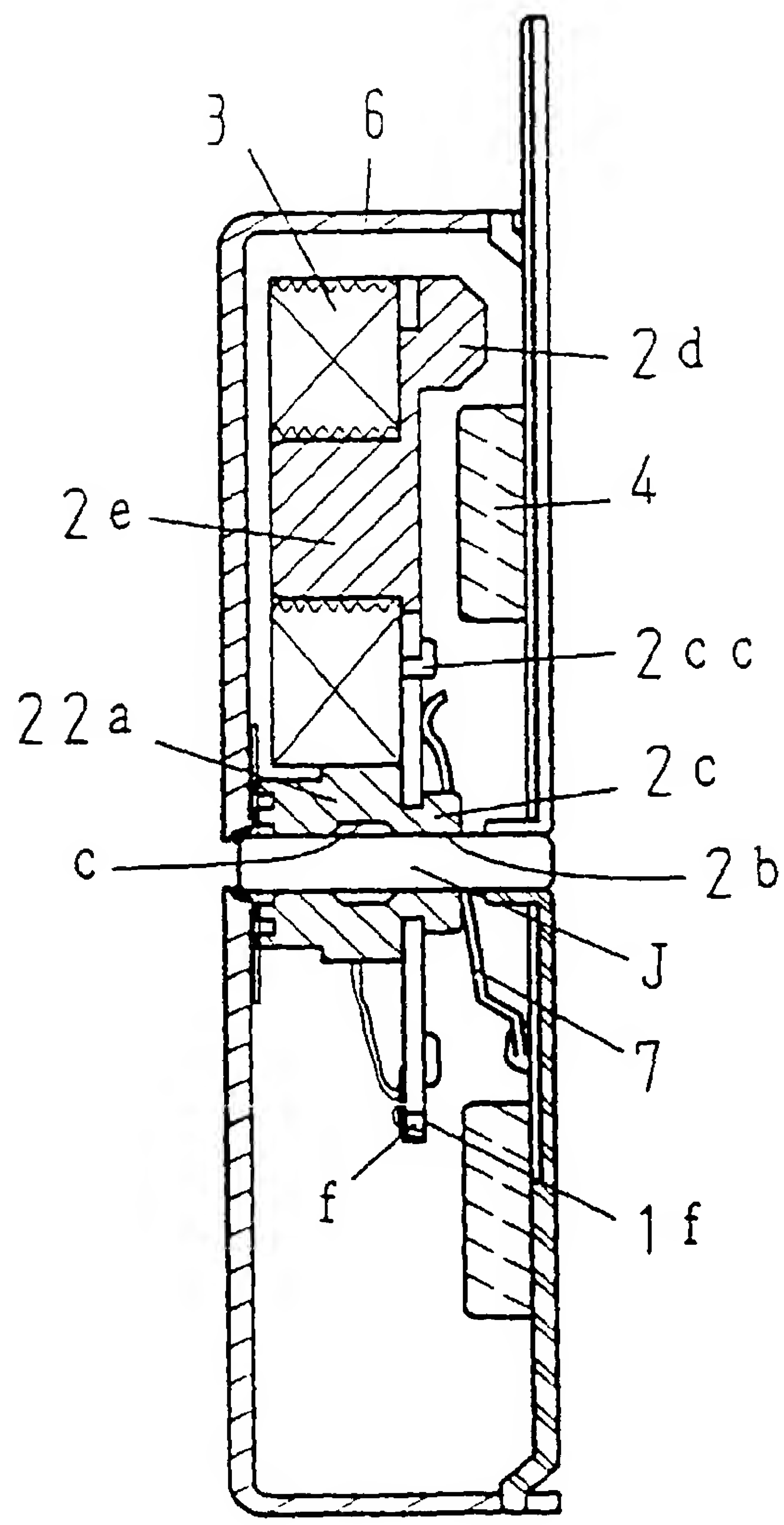


FIG. 7

1. 11. 111

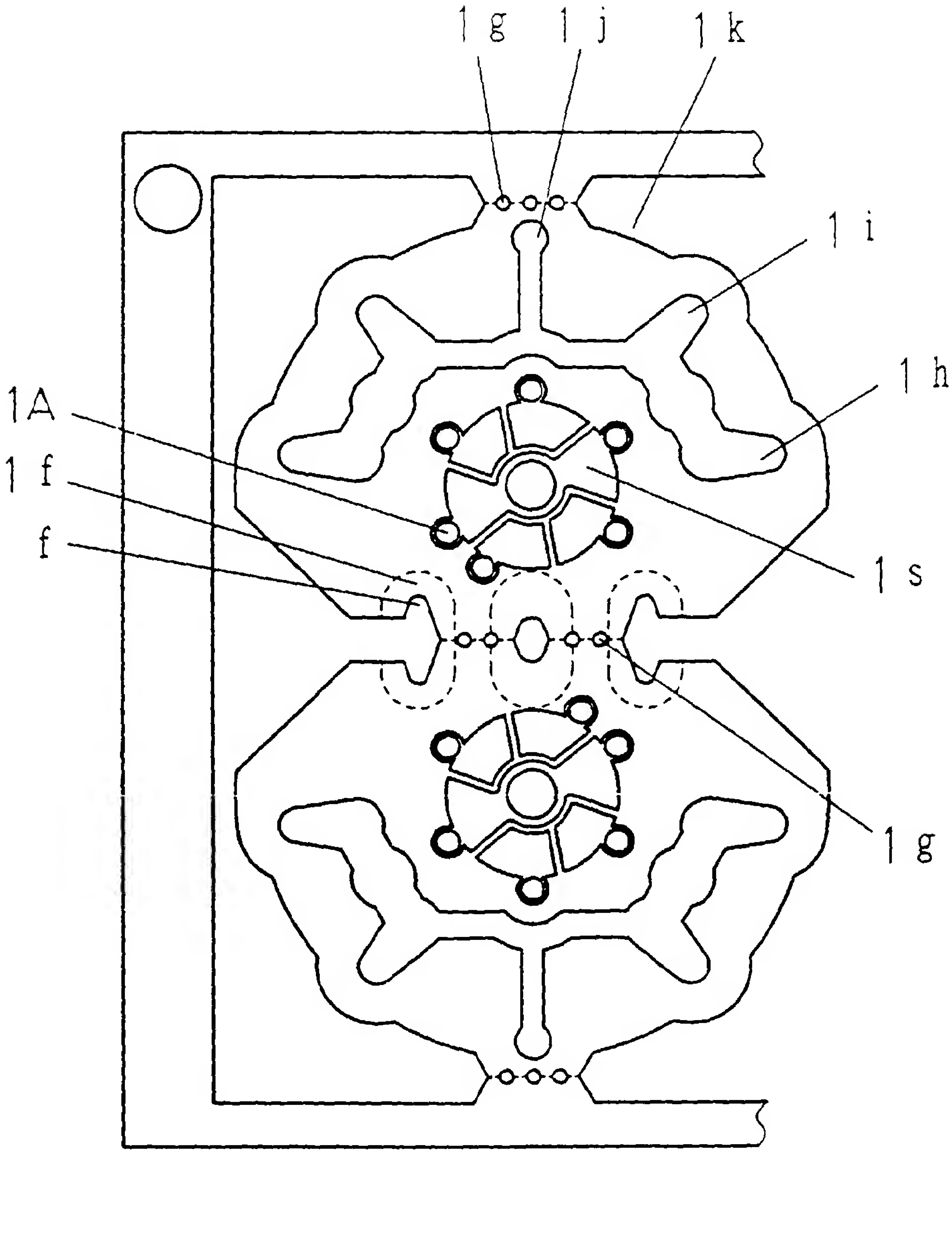


FIG. 8

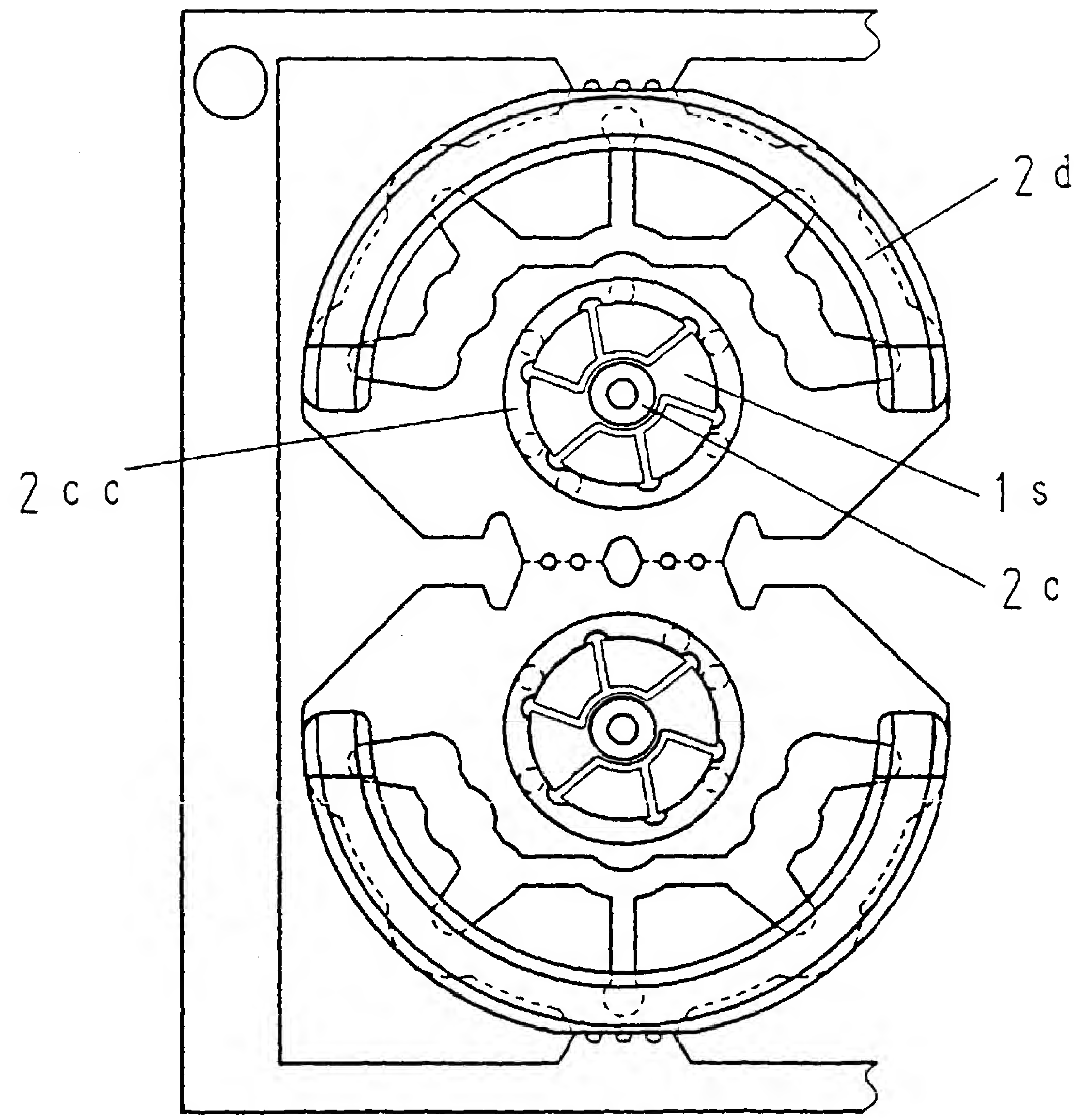


FIG. 9

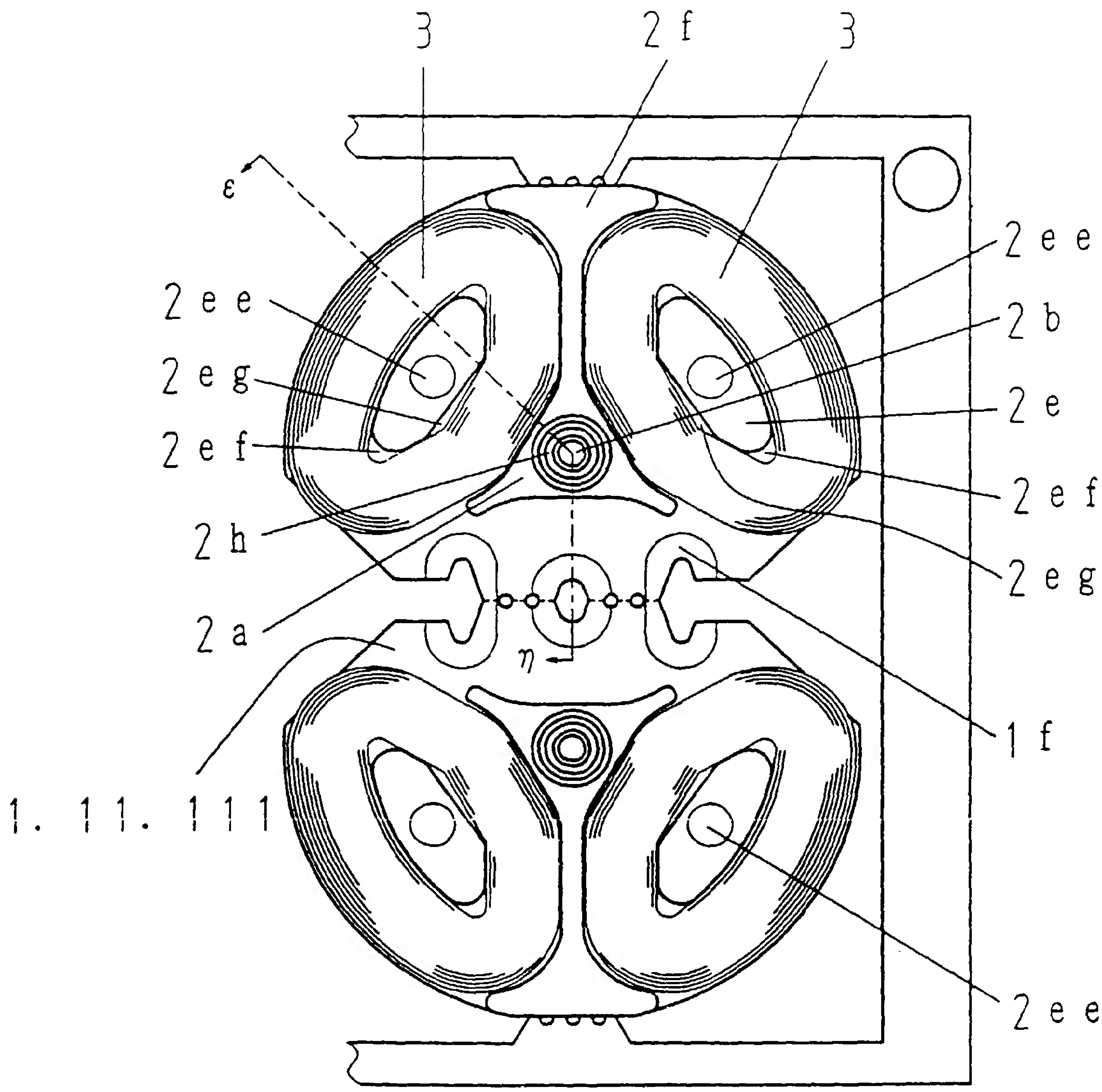


FIG. 10

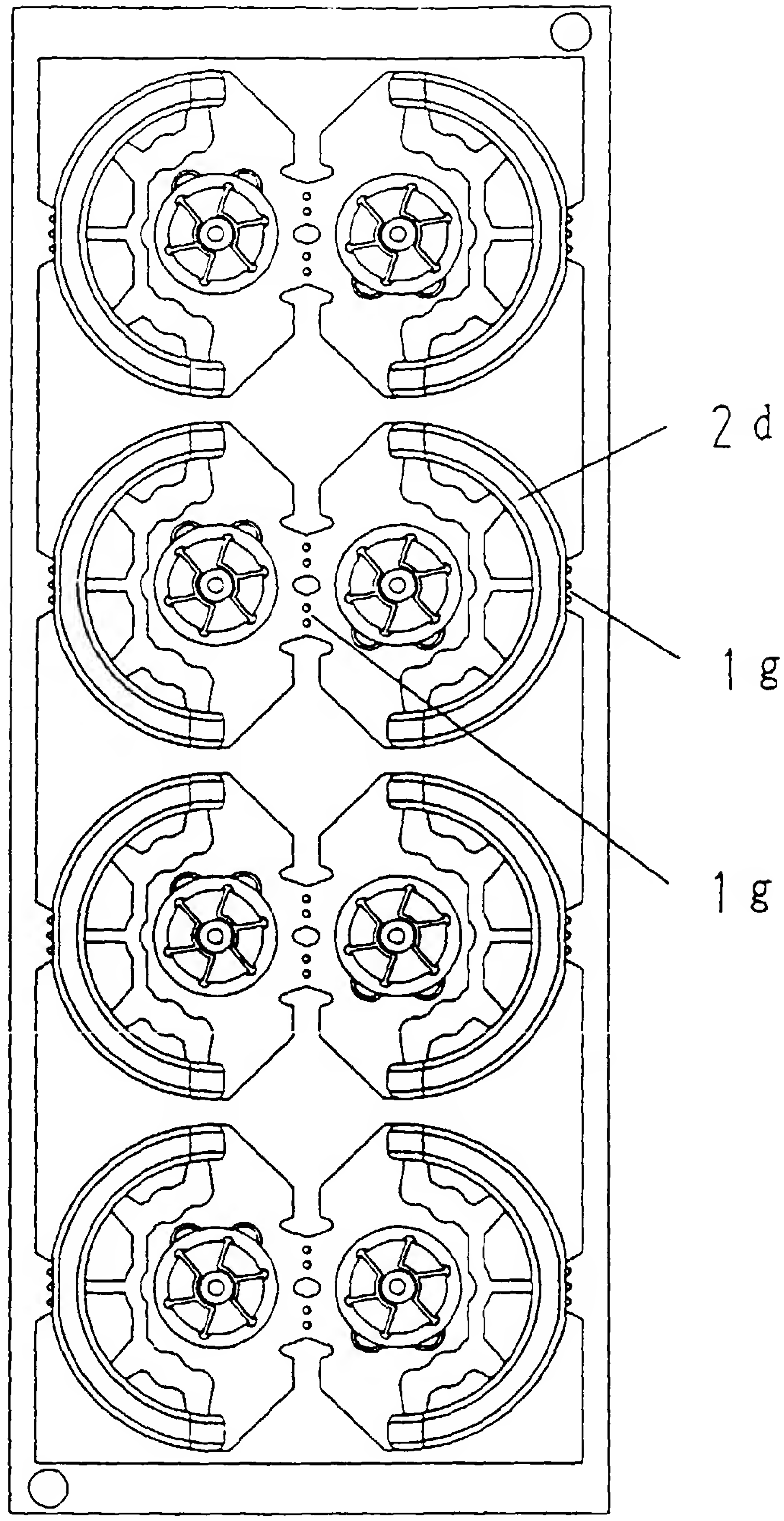


FIG. 11

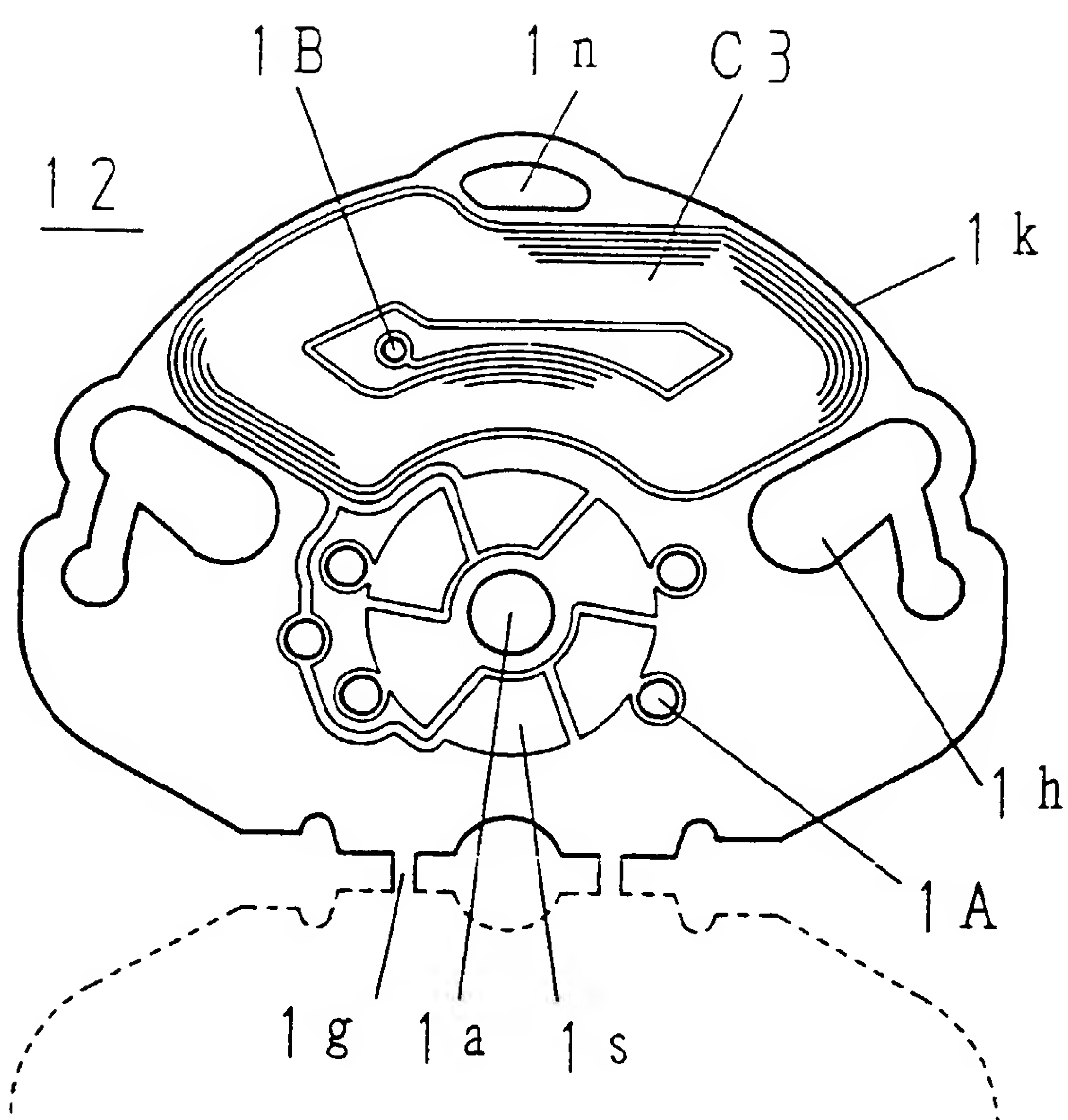


FIG. 12

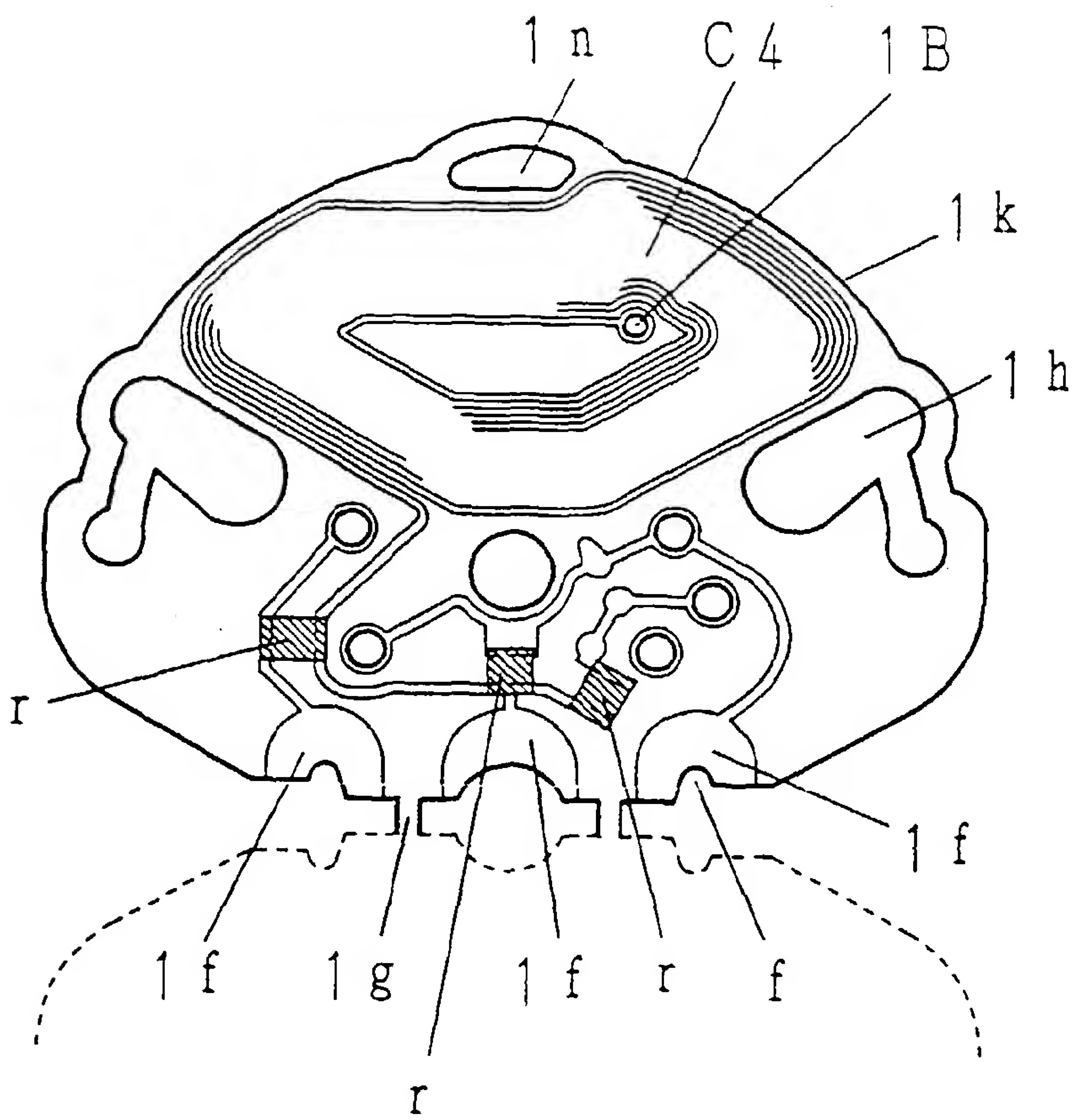


FIG. 13

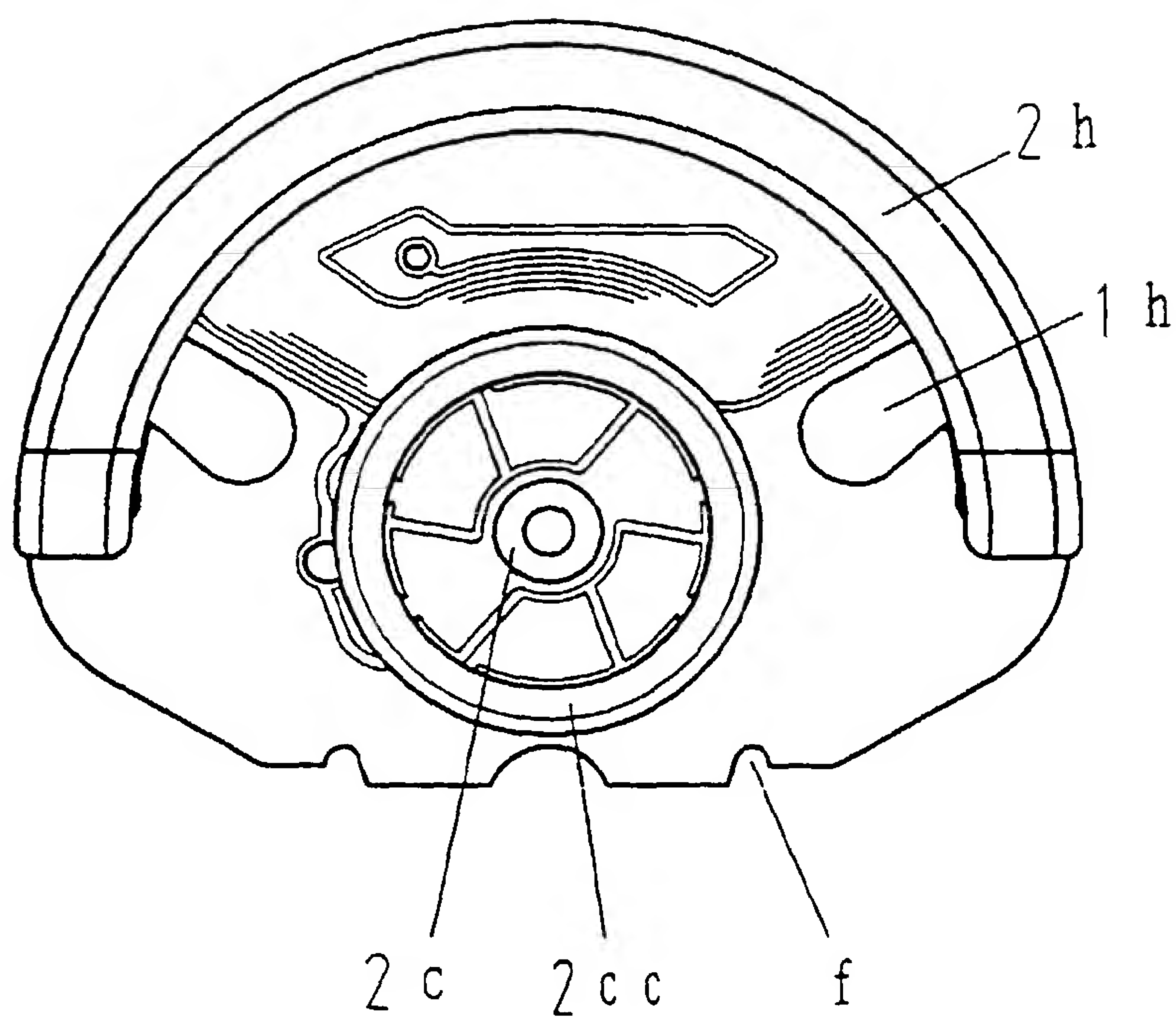


FIG. 14

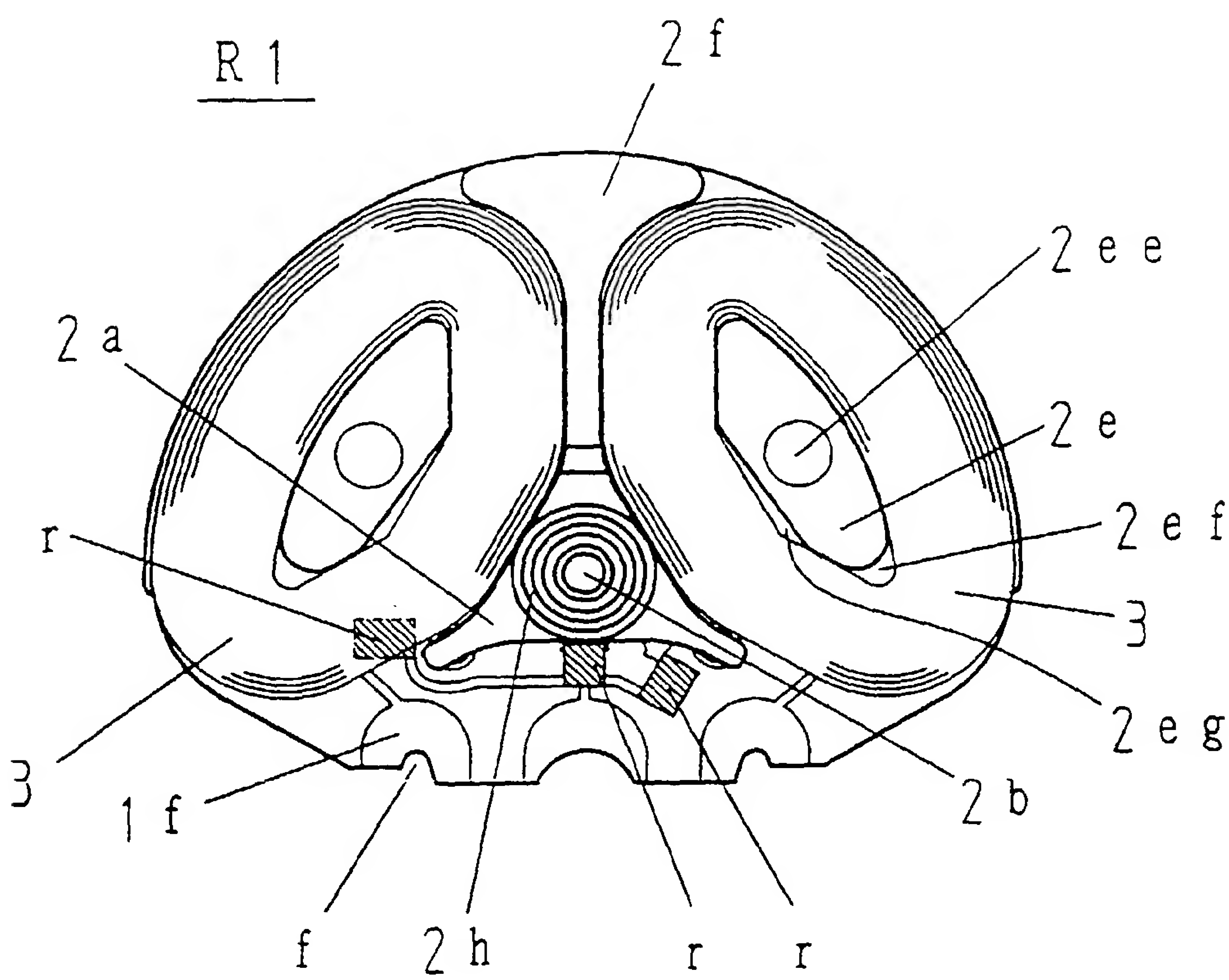


FIG. 15

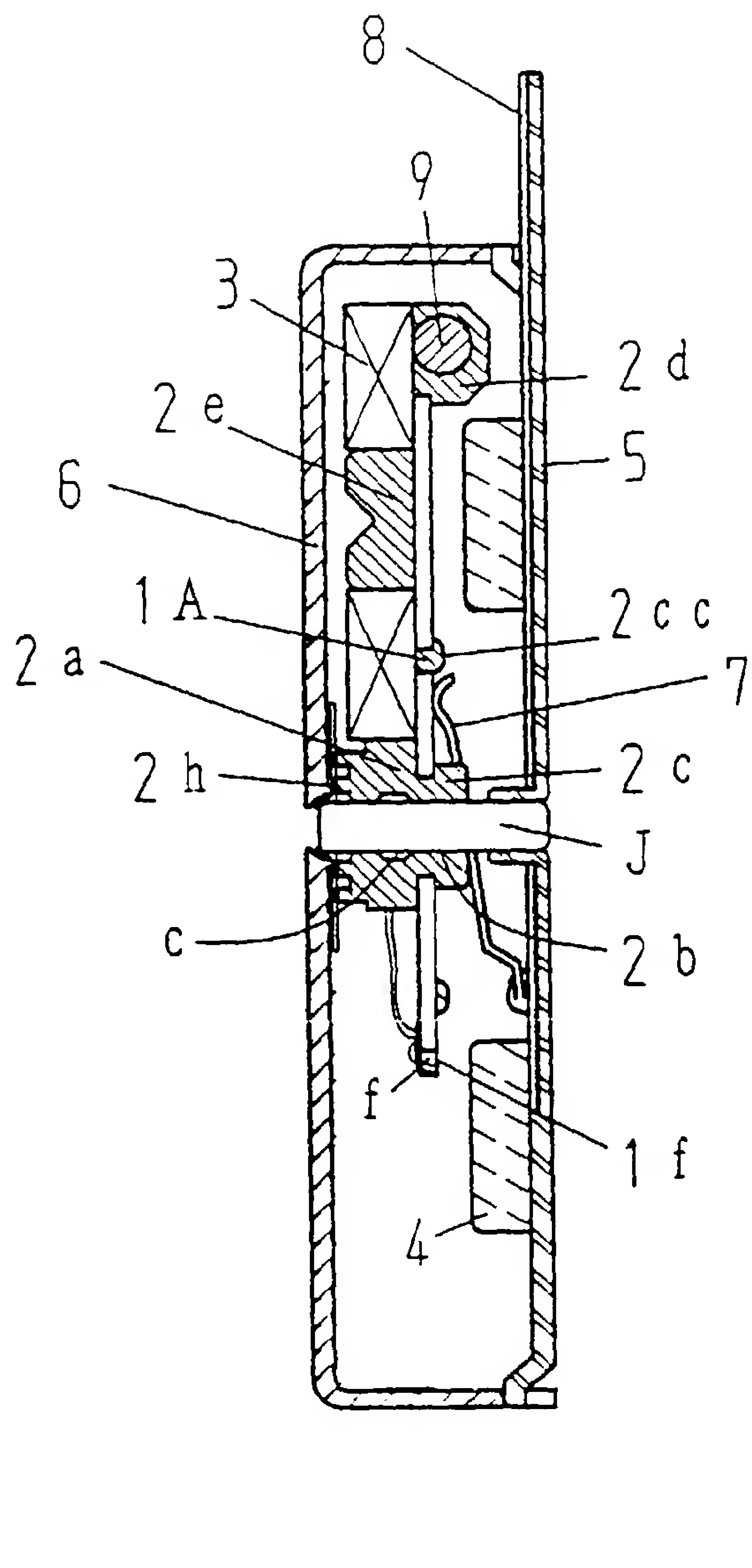
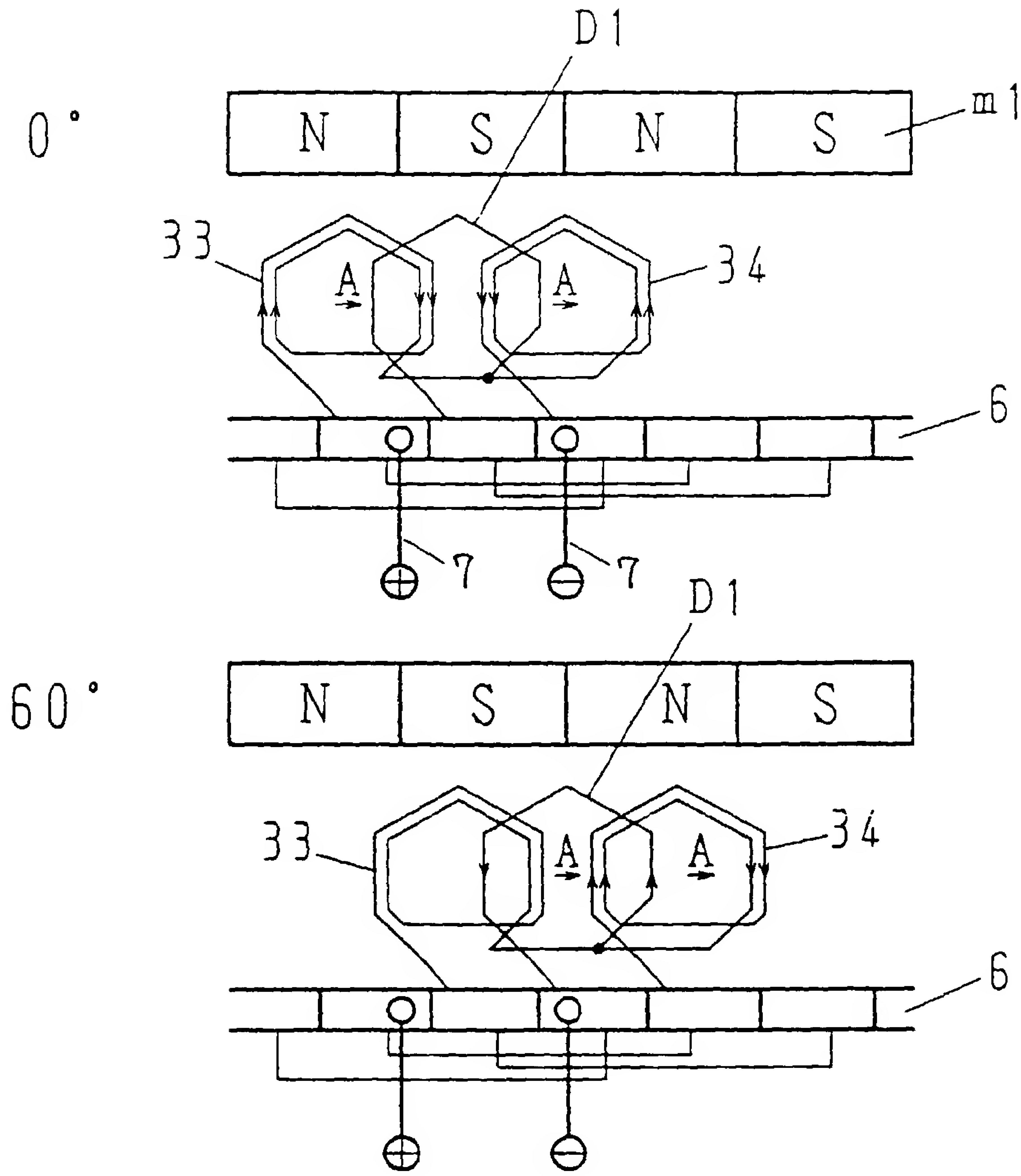


FIG. 16



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